REMARKS

By this amendment, the specification has been editorially amended, claims 2, 5, 9, 11, 14 and 18-20 have been cancelled, claims 1, 3, 6-7, 10, 12 and 15-16 have been amended and new claims 21 and 22 have been added in the application. Currently, claims 1, 3, 6-8, 10, 12, 15-17 and 21-22 are pending in the application.

Examiner Graham is thanked for the courtesies extended to the undersigned during the recent interview regarding this application. During the interview, Examiner Graham agreed that proposed amendments appear to overcome previous grounds of the rejection under 35 USC 112, first paragraph. Also, the nature of the variables (T, N, i) were discussed, as well as including the portable nature of the device as part of the claimed limitations.

By this office action, the Examiner stated that the specification was objected because of the following informality: on page 5, line 20, the process of Fig. 3 is referred to as being "parallel". However, the Examiner stated that Fig. 3 appears to illustrate a serial processing of functions A and then B. By this amendment, the specification was amended to recite "If there is a deviation in the throughputs of the process A and the process B,

it is necessary to complete both the processes A and B within one frame period T as shown in FIG. 3 unless the process A and the process B are made parallel". It is respectfully submitted that the objection to the specification should be withdrawn in view of this amendment.

Claims 10-12 and 14-18 were rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. The Examiner stated that claim 10 discloses "main signal processing section...which completes a first process within a period T" and "first process excludes information generated in a past time frame". The Examiner also stated that claim 10 discloses "first to Nth sub signal processing sections ... completing a second process within a period T" with second process "using the information generated in the past time frame". The Examiner believed that these limitations appear to conflict with, and are not supported by the specification. By this amendment, independent claim 10 has been amended to add the subject matter of previously presented claims 11 and 14 and applicants have deleted the phrases "wherein said first process excludes information generated in a past frame time; and said second process using the information generated in the past frame time". Also, independent claim 18 has been cancelled in this

amendment. Applicants respectfully submit that this rejection should be withdrawn in view of the amendments to the claims.

Claims 1, 2, 8-11 and 17-18 were rejected under 35 USC 103(a) as being obvious over by Ahamed et al. (U.S. Patent No. 5,978,831). Claims 3 and 12 were rejected under 35 USC 103(a) as being obvious over Ahamed et al. in view of Matt et al. (U.S. Patent No. 6,581,153). Claims 5-7 and 14-16 were rejected under 35 USC 103(a) as being obvious over Ahamed et al. in view of the applicants admitted prior art. Claims 19 and 20 were rejected under 35 USC 103(a) as being obvious over Ahamed et al. in view of Buchhein (U.S. Patent No. 6,061,306).

These rejections are respectfully traversed in view of the amendments to the claims and the following remarks.

The present invention relates to a signal processing device and a signal processing method performing a compressing/decoding process for an audio signal, and more specifically to a signal processing device and method in which the power consumption is reduced by making the processing parallel.

The present invention specifically discloses that in Fig. 5, the first digital signal may, for example, be a compressed and encoded signal of an audio signal, and the second digital signal may be a PCM signal of an audio signal. The first process may

contain a process picking out information from that compressed and encoded signal and converting that information into the information of a frequency spectrum, and the second process may contain a process converting the information of that frequency spectrum into a time based PCM signal.

In Fig. 11, the first digital signal may, for example, be a PCM signal of an audio signal, the second digital signal may be a compressed and encoded signal of an audio signal, the first process may contain a process converting the PCM signal into the information of a frequency spectrum, and the second process may contain a process compressing/encoding the information of the frequency spectrum.

Fig. 17 is an outline view showing one example of a portable type apparatus employing a signal processing device in accordance with either one of the embodiments in the present invention. This portable type apparatus is, for example, an apparatus for encoding and decoding to reproduce audio data, such as MP3, AAC, or the like. This apparatus is provided with a microphone 81 as an input device, an input section 82, an output section 83 amplifying a decoded signal, a speaker 84, a memory 85, and a battery 86 in addition to that signal processing device 87 as shown in the drawing. The signal processing device 87 is

constructed, including an encoding section 801 performing an encoding process of an audio signal in accordance with Embodiment 3 or 4 described above and a decoding section 802 performing a decoding process in accordance with Embodiment 1 or 2. The memory 85 is a memory holding audio data and is constructed so as to encode the data inputted thereto to write and decode the data written to output. The memory 85 can be constructed as a memory card that is small in size and is easy to attach or detach. With this, efficiently paralleling to encode and decode is possible, whereby advantageous effects can be produced wherein drastic low power consumption is achieved, and possible operating time can be prolonged by one time charge of the portable type apparatus.

Independent claim 1 has been amended to recite similar features to those previously presented in claims 2 and 5, specifically, "A portable audio device having a signal processing device for performing digital audio decoding comprising: a distribution section which divides a first digital signal framed for each predetermined time interval to $(N \times t + i)$th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) and distributes said frame signals for each frame interval one after another", "a selection section which

selects one of a processed signal outputted from said first to Nth sub signal processing sections for each frame interval one after another" and "wherein said first digital signal is a compressed and encoded signal of an audio signal; said second digital signal is a PCM signal of an audio signal; said first process contains a process picking out information from the compressed and encoded signal to convert the information into information of a frequency spectrum; and said second process contains a process converting said information of said frequency spectrum into said PCM signal having a time basis".

Claim 3 has been amended to be an independent claim and recite similar features to those previously presented in claims 1 and 5, specifically, "A portable audio device having a signal processing device for performing digital audio decoding comprising: first to Nth sub signal processing sections each of which is given $(N \times t + i)$th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) of a first digital signal framed for each predetermined time interval and each of which completes a first process within a period $(N \times T)$ (T is a real number); a first memory which stores said frame signal of said first digital signal one after another; a main

signal processing section which converts a signal processed in said (i + 1)th sub signal processing section into a second digital signal by completing a second process within a period T" and "said first digital signal is a compressed and encoded signal of an audio signal; said second digital signal is a PCM signal of an audio signal; said first process contains a process picking out information from the compressed and encoded signal to convert the information into information of a frequency spectrum; and said second process contains a process converting said information of said frequency spectrum into said PCM signal having a time basis".

Independent claim 10 has been amended to recite similar features to those previously presented in claims 11 and 14, specifically, "A signal processing device for performing digital audio encoding comprising: a main signal processing section which is given (N × t + i)th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) of a first digital signal framed for each predetermined time interval and which completes a first process within a period T (T is a real number); a distribution section which divides said frame signal outputted from said main signal processing section into said

first to Nth frame signal for each frame interval one after another" and "a selection section which selects one of the after-process signals outputted from the first to Nth sub signal processing sections for each frame interval one after another; wherein said first digital signal is a PCM signal of an audio signal; said second digital signal is a compressed and encoded signal of an audio signal; said first process contains a process converting said PCM signal into information of a frequency spectrum; and said second process contains a process encoding and compressing said information of said frequency spectrum".

Claim 12 has been amended to be an independent claim and recite similar features to those previously presented in claims 10 and 14. Specifically, claim 12 recites "A signal processing device for performing digital audio encoding comprising: a main signal processing section which is given $(N \times t + i)$th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) of a first digital signal framed for each predetermined time interval and which completes a first process within a period T (T is a real number); a first memory stores said frame signal of said first digital signal one after another; first to Nth sub signal processing sections each of which is

given the (i + 1)th frame signal after the first digital signal has been processed in said main signal processing section and converts the frame signal into a second digital signal by completing a second process within a period (N x T)" and "said first digital signal is a PCM signal of an audio signal; said second digital signal is a compressed and encoded signal of an audio signal; said first process contains a process converting said PCM signal into information of a frequency spectrum; and said second process contains a process encoding and compressing said information of said frequency spectrum".

Applicants respectfully submit that amended independent claims 1, 3, 10 and 12 define over all of references used in rejections under 35 USC 103(a) including Ahamed et al., Matt et al., applicants admitted prior art, Buchheim or any combinations of these references because these references do not show the features of amended independent claims 1, 3, 10 and 12 as discussed below.

Applicants respectfully submit that Ahamed et al., Matt et al. and the other prior art of record do not show or suggest the data packets is compressed, encoded audio signal or PCM audio signal. In the present invention, sub processing sections perform the first process of picking out information from the

compressed and encoded signal and converting the information into information of a frequency spectrum. The main signal processing section performs the second process converting the information of the frequency spectrum into the PCM signal.

The Examiner admitted that Ahamed et al. do not disclose that the first digital signal is a compressed and encoded signal. The Examiner also admitted that Ahamed et al. do not disclose that the second digital signal is a pulse code modulated (PCM) signal of an audio signal. The Examiner also admitted that Ahamed et al. do not disclose that the first process involves converting the information in the data into the frequency spectrum. The Examiner also admitted that Ahamed et al. do not disclose that the second process converts the frequency spectrum signal into a time based PCM signal.

Ahamed et al. relate to the architecture of multiprocessor computers. Ahamed et al. disclose in FIG. 1 that the faster processor 12 operates at three times the rate of the slower processor 11. The timing diagram for the arrangement of FIG. 1 is shown in FIG. 2. The top time line in FIG. 2 shows the arrival times of data blocks 16. Each of the subsequent time lines shows the progression of individual data blocks 16 of a frame 15 through the arrangement of FIG. 1.

Ahamed et al. also disclose that the input gating function 317 distributes to the processors 300 sets of data blocks 316 of input frames 315. Each processor 300 processes the received data blocks 316 into output data blocks 326, which are gathered and assembled by the output gating function 318 into output frames 325.

Ahamed et al. also disclose that for example, if a conventional pipeline 400 has four stages 401, 402, 403 and 404 as shown in Fig. 13, then each of the stages needs the same finite amount of time for execution. That way, each one of the stages of the pipeline is continuously busy, with data blocks following in the 401, 402, 403 and 404 sequence through the pipeline 400.

Ahamed et al. also disclose that when the overall pipe line speed needs to be speeded up k times, this requires that the throughput of each of the stages is also enhanced k times.

The Examiner believed that any arbitrary segment such as the middle or later pipeline stages (1402-1404) in Ahamed et al. reads on a "main signal processing section which converts a signal processed in said (i + 1)th sub signal processing section into a second digital signal" (see page 7, lines 8-14 in the Office Action). The Examiner also stated that Ahamed discloses

that each stage of the pipeline would need the same execution time. According to the Examiner's interpretation, for example, if the stage 1401 of Ahamed et al. takes a time (N x T), each one of the pipeline stages (1402-1404) takes the same amount of time (N x T). Therefore, the total time to complete the process for each i in Ahamed et al. will be 2(N x T). This is quite different from the present invention.

Ahamed et al. do not disclose many of the features in the independent claims. Examples of these missing features are discussed below.

Ahamed et al. do not disclose a portable audio device having a signal processing device for performing digital audio decoding as claimed in claims 1 and 3.

Ahamed et al. also do not disclose that the first digital signal is a compressed and encoded signal of an audio signal; the second digital signal is a PCM signal of an audio signal; the first process contains a process picking out information from the compressed and encoded signal to convert the information into information of a frequency spectrum; and the second process contains a process converting the information of the frequency spectrum into the PCM signal having a time basis as claimed in claims 1 and 3.

Ahamed et al. also do not disclose that a first memory which stores said frame signal of said first digital signal one after another as claimed in claim 3.

Ahamed et al. also do not disclose that a second memory which stores said frame signal of said second digital signal one after another as claimed in claim 3.

Ahamed et al. also do not disclose a signal processing device for performing digital audio encoding as claimed in claims 10 and 12.

Ahamed et al. also do not disclose that the first digital signal is a PCM signal of an audio signal; the second digital signal is a compressed and encoded signal of an audio signal; the first process contains a process converting the PCM signal into information of a frequency spectrum; and the second process contains a process encoding and compressing the information of the frequency spectrum as claimed in claims 10 and 12.

Ahamed et al. also do not disclose that a first memory stores said frame signal of said first digital signal one after another as claimed in claim 12.

Ahamed et al. also do not disclose that a second memory stores said frame signal of said second digital signal one after another as claimed in claim 12.

Since claims 1 and 3 have been amended to incorporate the features similar to previously presented claim 5 and claims 10 and 12 have been amended to incorporate the features similar to previously presented claim 14, applicants respectfully submit that these claims are also allowable for the reasons discussed below. Claims 5 and 14 were rejected under 35 USC 103(a) based on a combination of Ahamed et al. and applicants admitted prior art. In this rejection, the Examiner admitted that Ahamed et al. do not disclose the features of claims 5 and 14.

Applicants respectfully submit that the discussion in the specification and Pohlmann do not teach or suggest that it would have been obvious to one of ordinary skill in the art to perform the digital audio encoding and decoding processes in the architecture of multiprocessor computers of Ahamed et al. Further, they do not teach or suggest the features of the amended independent claims 1, 3, 10 and 12. Therefore, applicants respectfully submit that Ahamed et al., applicants admitted prior art and Pohlmann, individually or in combination, do not teach or suggest the presently claimed features. Further, applicants respectfully submit that one of ordinary skill in the art would not have combined the applicants admitted prior art and Ahamed et al. to render the claimed invention obvious.

Matt et al. do not make up for the deficiencies in Ahamed et al. Matt et al. relate to an integrated circuit. Matt et al. disclose that the integrated circuit is characterized in particular in that it contains a router which controls the data traffic between the processor and the modules. Through the use of the router, the triggering of the modules is removed from the processor.

Matt et al. also disclose that the processor DSP transfers out simple processes which are carried out in modules M1, M2 and M3. The processor DSP transfers to the router ROUTER data packets and associated instructions for special operations which can be performed by modules M1, M2 and M3 to be performed in the specified sequence.

Matt et al. also disclose that the router ROUTER has the task of autonomously coordinating the sequence, transferring the data packets to the appropriate modules M1, M2 and M3 and according to the specified instructions.

Matt et al. also do not disclose that the first digital signal is a compressed and encoded signal of an audio signal; the second digital signal is a PCM signal of an audio signal; the first process contains a process picking out information from the compressed and encoded signal to convert the information into

information of a frequency spectrum; and the second process contains a process converting the information of the frequency spectrum into the PCM signal having a time basis as claimed in claims 1 and 3.

Matt et al. also do not disclose that the first digital signal is a PCM signal of an audio signal; the second digital signal is a compressed and encoded signal of an audio signal; the first process contains a process converting the PCM signal into information of a frequency spectrum; and the second process contains a process encoding and compressing the information of the frequency spectrum as claimed in claims 10 and 12.

Matt et al. also do not disclose the other features in the independent claims. Examples of these missing features are discussed below.

Matt et al. do not disclose a portable audio device having a signal processing device for performing digital audio decoding as claimed in claims 1 and 3.

Matt et al. also do not disclose that first to Nth sub signal processing sections each of which is given said frame signals from said distributing section, and each of which completes a first process within a period (N × T) (T is a real number) as claimed in claim 1.

Matt et al. also do not disclose that first to Nth sub signal processing sections each of which is given (N × t + i)th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) of a first digital signal framed for each predetermined time interval and each of which completes a first process within a period (N × T) (T is a real number) as claimed in claim 3.

Matt et al. also do not disclose a signal processing device for performing digital audio encoding as claimed in claims 10 and 12.

Matt et al. also do not disclose first to Nth sub signal processing sections each of which is given the (i + 1)th processed frame signal from said distribution section and converts said frame signal into a second digital signal by completing a second process within a period (N × T) as claimed in claim 10.

Matt et al. also do not disclose first to Nth sub signal processing sections each of which is given the (i + 1)th frame signal after the first digital signal had been processed in said main signal processing section and converts the frame signal into

a second digital signal by completing a second process within a period (N x T) as claimed in claim 12.

Buchheim does not make up for the deficiencies in Ahamed et al. Buchheim relates to an audio player and, more particularly, to a portable digital audio device which is also structurally and functionally compatible with a cassette player and may therefore also be used as a digital cassette playable by a conventional, i.e., analog, cassette player.

Buchheim discloses that device 10 includes a digital audio player 14. Chip 18 is adapted at encoding and decoding audio data compressed formats. The memory 16 and the audio chip 18 can be integrated into a single audio-memory chip as well known in the art. The memory 16 can be of any type, but not limited to, RAM, ROM or Flash memory.

Buchheim does not disclose that the first digital signal is a compressed and encoded signal of an audio signal; the second digital signal is a PCM signal of an audio signal; the first process contains a process picking out information from the compressed and encoded signal to convert the information into information of a frequency spectrum; and the second process contains a process converting the information of the frequency

spectrum into the PCM signal having a time basis as claimed in claims 1 and 3.

Buchheim does not disclose that the first digital signal is a PCM signal of an audio signal; the second digital signal is a compressed and encoded signal of an audio signal; the first process contains a process converting the PCM signal into information of a frequency spectrum; and the second process contains a process encoding and compressing the information of the frequency spectrum as claimed in claims 10 and 12.

Buchheim also does not disclose the other features in the independent claims. Examples of these other missing features are discussed below.

Buchheim also does not disclose that first to Nth sub signal processing sections each of which is given the frame signals from the distributing section, and each of which completes a first process within a period (N × T) (T is a real number) as claimed in claim 1.

Buchheim also does not disclose that first to Nth sub signal processing sections each of which is given (N × t + i)th frame signals (i and t are integers, N is a natural number greater than 1, and $0 \leq i < N$) of a first digital signal framed for each

predetermined time interval and each of which completes a first process within a period (N x T) (T is a real number) as claimed in claim 3.

Buchheim also does not disclose that first to Nth sub signal processing sections each of which is given the (i + 1)th processed frame signal from said distribution section and converts said frame signal into a second digital signal by completing a second process within a period (N x T) as claimed in claim 10.

Buchheim also does not disclose that first to Nth sub signal processing sections each of which is given the (i + 1)th frame signal after the first digital signal had been processed in said main signal processing section and converts the frame signal into a second digital signal by completing a second process within a period (N x T) as claimed in claim 12.

Therefore, applicants respectfully submit that Ahamed et al. and other cited references, individually or in combination, do not teach or suggest the presently claimed features. Further, applicants respectfully submit that one of ordinary skill in the art would not have combined these references to render the claimed invention obvious. Also, there is no teaching or

suggestion for the proposed combinations in the applied references.

New independent claims 21 and 22 have been added to the application. Claims 21 and 22 recites features similar to previous claims 1 and 10 respectively and specifically, they both include the feature that "the first process and the second process are completed for each i in a period (N x T + T)". Applicants respectfully submit that the features of claims 21 and 22 define over the prior art of record because the total process time of Ahamed et al. for each i takes 2(N x T) in the pipeline stages as discussed above using the Examiner's interpretation. However, the total process time for the first and second processes in the present invention takes (N x T + T) (see Figs. 8 and 14 of the drawings) which is significantly less than Ahamed et al. Therefore, applicants respectfully submit that claims 21 and 22 are also allowable.

In view of foregoing amendments and remarks, it is respectfully submitted that the pending claims are allowable over the prior art of record. Thus, applicants respectfully submit that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding the amendments or these remarks, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,

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